

ENGINEERING CASE LIBRARY

Indhina

Whether to Make a Better Water Purifier

The case you are about to read is fictional, but the problem concept is real and the need for careful value judgment is imperative - as it is in many situations that arise in the activities of a design engineer. You are about to become a key engineer and part owner in a small company in a foreign land. You are confronted with a total design situation in which you must assess the needs of men, design products to meet the needs, and study the effect of your efforts on satisfying these needs. Specifically, you are to discuss the results of your study and the pertinent factors leading to your conclusions.

(c) 1964 by the Board of Trustees of Leland Stanford Junior University. Prepared in the Design Division, Department of Mechanical Engineering, Stanford University by John M. Leslie as a basis for engineering class projects.

The country is Indhina. It has a population of 100 million people, over 80% of whom are illiterate. The country is still an agrarian society with man and animal supplying the muscle power to till the soil, pump water, etc. The majority of the people have never seen a tractor, an automobile, or a paved road; they are religious and predominately Catholic. Population and the available food supply has reached an equilibrium point where the average person is existing on approximately 1800 calories input per day. The typical husband and wife bring six children into the world but one third of the children die before they reach the age of puberty. The average life expectancy of an adult is 40 years. The average annual salary for the head of a household is \$100.00. The people are destitute and spend most of their life in pain due to illness. This has been the pattern of Indhina for centuries.

You are an exceptionally capable design engineer - a few years ago in Palo Alto you met a wealthy businessman and formed a quick and lasting friendship. Your friend has a broad background in the fields of economics, social sciences, medicine, and business administration; you are strong in material science, mechanical engineering, and industrial engineering. Both you and your friend are highly motivated to bring "good" to mankind, and decide to form a partnership and go to Indhina to help the inhabitants of that country. You plan to use your combined wealth of knowledge to help respond to some significant need of the people.

Upon visiting Indhina, you learn with good scientific validity that the high death rate of both children and adults and a great deal of illness can be directly attributed to virus contamination within the drinking water. (The people obtain water from their nearest river, stream, or spring.) You and your friend learn further that the death rate of children can probably be reduced by 50%, and the life of adults can probably be extended ten years if the inhabitants drink "virus" free water.

At this point you and your friend decide that you can do a great service to the people of Indhina by designing an inexpensive, family size, water purifier that will substantially reduce the virus count in the drinking water. You and your friend decide upon a particular town of 20,000 people in which to

start your project. You establish the following objectives for the final product design:

1. Use existing natural resources as much as possible.
2. Employ village inhabitants as much as practical to manufacture the units.
3. Maintain a sales price of under five dollars per unit so that it is within financial reach of many families.
4. Establish a broad distribution system to make the unit available to people everywhere within the country.

You are successful in designing a satisfactory water purifier that has a 75% probability of removing all virus. It is compact, virtually fool-proof to operate, and will adequately handle the drinking water requirements of an individual family. It can be manufactured from locally obtained materials and by members of the local village population. You and your friend establish a bonafide manufacturing plant in the village. You head both the engineering and manufacturing operations; your friend handles the responsibilities of company president (he put up the \$250,000 to construct the plant). All other personnel are natives of the village; you and the president personally train all key employees.

After two years of operation, Indhina, as a result of your company's efforts, has been able to notice a definite down turn in the death rate in those families using the purifier. The local village where your plant is located has been able to more than double its annual level of income; your employees have adjusted their standard of living to a height never before realized in their history.

You have not been idle, engineering-wise, during these two years; you realize that the unit you are currently manufacturing is expensive (\$5.00 each) and is only 75% certain of being virus free; you also recognize that your maximum production level of some 300,000 units per year would require over 50 years to cover the total population of Indhina if the population did not increase - and you know it will. After two years, you have successfully developed a unique new model of water purifier that has a 95% probability of being virus free, can be sold for one dollar, and can be manufactured at the rate of 20,000 per week. The only difficulty is that to meet the high standards

of reliability and the low sales price you must automate your manufacturing operation.

If you decide to produce the new unit, instead of the old, you will have to invest an additional \$250,000 into your plant (your altruistic partner is willing to do this), and you will require only 500 employees to maintain your production level.

You and your friend recognize that you have a serious decision to make as to whether to continue with the old design or introduce the new one. You decide to carefully look at the pros and cons of the situation and make the decision that you think is best for mankind.

Now, what decision will you reach? Are you satisfied with your earlier decisions? Discuss the factors pertinent to your conclusions!